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The influence of the SITARI information system (independent non-communicable disease screening) on the accuracy and speed of screening for non-communicable diseases

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ABSTRACT

Deaths from Non-Communicable Diseases (NCDs) are the largest proportion of deaths in various countries. Its prevalence reaches 71% of deaths globally, where 77% of NCD sdeaths occur in countries that are only middle to lower. NCDs detection/screening and treatment, as well as palliative care, are key components of NCDs management. Implementation of the Independent Non-Communicable Diseases Screening/*Skrining Penyakit Tidak Menular Mandiri* (SITARI) allows women of childbearing age to screen for non-communicable diseases independently. So that the acceleration of the fulfillment of quality maternal health services in Blora Regency can run well. The purpose of this study was to determine the effect of the SITARI information system (independent non-communicable disease screening) on the completeness and speed of screening for NCDs. Based on statistical tests it is known that the significance value is 0.000 (*p*, <0.05), meaning that there is a difference in the completeness of the data between women of childbearing age (WCA) who use SITARI and WCA who do not use SITARI with a mean difference of 26.09 and a significance value of 0.000 (*p*, <0.05), meaning that there is a difference in screening speed for WCA who use SITARI and WCA who do not use SITARI with a mean difference of 10.80. This proves that the completeness and speed of NCDS screening using SITARI is better than those not using it.

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INTRODUCTION

Globally, deaths caused by non-communicable diseases (NCDs) have increased substantially, with the proportion of global deaths attributable to NCDs rising from nearly 61 % in 2000 to almost 74 % in 2019.(1) NCDs not only impose a heavy health burden but also threaten economic growth and constitute a major social burden for developing countries.(2) More than 80 % of NCD-related deaths are due to cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. Women and children in low- and middle-income countries (LMICs) bear a triple burden of poor health conditions related to reproduction, communicable diseases, and non-communicable diseases. Two out of every three deaths

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among women globally are caused by NCDs. Thus, NCDs represent a significant threat to both maternal health and population health worldwide.(3)

In Indonesia, NCDs have also emerged as one of the leading contributors to maternal mortality. In 2019, 4,221 maternal deaths were recorded, of which 1,423 cases (33.7 %) were attributed to NCDs.(4) In Central Java Province, including Blora Regency, maternal deaths caused by NCDs ranked third among the leading causes. In Blora, the most prevalent NCDs in 2020 were hypertension, diabetes mellitus, and bronchial asthma.(5) Although the government has implemented the *Posbindu PTM* program (Integrated Development Post for NCD Control) as a community-based empowerment initiative for NCD prevention, its implementation still faces multiple obstacles including public perception toward screening, disruptions caused by the COVID-19 pandemic, and suboptimal data recording and reporting systems.(6,7) These challenges suggest that NCD screening and detection among women of reproductive age in Blora remain far from optimal.

Although NCD screening and early detection are recognized as key components of NCD prevention and control, field implementation remains limited by low coverage, incomplete data, and delayed or inaccurate reporting and follow-up. For example, in Sri Lanka, only 23 % of individuals aged ≥ 35 years were screened within two years after the introduction of a primary-care strengthening program, and considerable variation was observed in the accuracy of record-keeping.(8) Similarly, in Vietnam, a community-based mobile application for NCD screening achieved substantially fewer recording errors (< 1 % for anthropometric data) and faster reporting than traditional paper-based methods.(9) A scoping review on digital health interventions for NCD management in LMICs also found that, while clinical outcomes vary, implementation outcomes including timeliness and data quality show consistent improvement with digital systems.(10) Collectively, these findings provide a strong scientific rationale for the use of digital information systems in NCD screening: they accelerate data collection, minimize human error, enable real-time reporting and follow-up, and enhance data accuracy through automated validation and system integration. However, in many local contexts such as Blora, no study has yet evaluated the specific impact of an independent digital screening system on the speed and accuracy of NCD screening among women of reproductive age.

To address these challenges, the *SITARI* (*Skrining Penyakit Tidak Menular Mandiri*/ Independent Non-Communicable Disease Screening Information System) was developed as an innovative digital tool enabling women of reproductive age to perform self-screening for NCD risk factors through an integrated digital platform connected to community and health-center databases. Conceptually, SITARI is designed to streamline the screening process from data entry, self-assessment or assisted measurements, to automatic reporting while improving accuracy through built-in electronic validation and automated follow-up notifications. By doing so, SITARI aims to bridge the existing gap of delayed and inaccurate NCD screening within resource-limited community settings such as Blora Regency.

Therefore, this study aims to analyze the effect of the SITARI information system on the speed and accuracy of non-communicable disease screening among women of reproductive age in Blora Regency. The study addresses the following research question: Does the implementation of SITARI improve (1) the speed of NCD screening and (2) the accuracy of screening results compared to conventional community-based methods? The central hypothesis proposes that the use of SITARI will significantly enhance both the speed and the accuracy of NCD screening compared to conventional screening approaches.

METHOD

This study employed a quasi-experimental posttest-only control group design. The design was chosen to compare outcomes between an intervention group and a control group without randomization, as random assignment was not feasible in the community setting.

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Data collection was conducted from March to June 2024 in Blora Regency, Central Java, Indonesia. The posttest-only approach was used to avoid potential bias from pretest sensitization and to capture real-world implementation effects. Each participant underwent a single round of screening during the study period. The study population consisted of Women of Reproductive Age (WRA), defined as women aged 15–49 years, residing in Blora Regency. Eligible participants included those who were in good health, at risk of non-communicable diseases (NCDs), or already diagnosed with NCDs. A purposive sampling technique was employed to select respondents who met the inclusion criteria and were accessible for intervention. The sample size comprised 118 participants, with 59 in the intervention group (SITARI users) and 59 in the control group (non-users).

Inclusion criteria were women aged 15–49 years living in Blora Regency, able to operate or be assisted in operating the SITARI system, and willing to participate and provide informed consent. Exclusion criteria were women unable or unwilling to use the SITARI system and declined participation or withdrew during the study. Participant recruitment was carried out through local community health posts (*Posyandu*) and the Integrated Development Post for NCD Control (*Posbindu PTM*), in collaboration with midwives and community health workers (*kader kesehatan*). The intervention involved the use of SITARI (Independent Non-Communicable Disease Screening Information System), a digital screening platform designed to facilitate self-assessment and recording of NCD risk factors among women of reproductive age. Participants in the intervention group were trained by health workers on how to use SITARI, which includes digital input of personal health data (age, BMI, blood pressure, blood glucose, smoking status, and physical activity). The system automatically calculated NCD risk scores and generated screening outcomes. Data were stored and transmitted to a centralized health database for verification by the local health office. The control group underwent conventional screening using standard manual methods conducted by health workers at community health posts, involving paper-based forms and manual calculation of risk factors. The duration of SITARI use per participant was approximately 20–30 minutes, including training, data entry, and verification. Two main outcome variables were measured: (1) Screening Speed: measured as the total time (in minutes) required to complete the entire screening process from initiation to result generation; (2) Screening Accuracy: measured as the degree of concordance between the participant's screening result (via SITARI or manual method) and the verification result by a health professional, expressed as a percentage agreement. All measurements in the control group were conducted using validated manual instruments (digital sphygmomanometer, glucometer, and anthropometric tools). In the SITARI group, data were recorded through the application interface, which had undergone prior internal validation and usability testing by the Blora District Health Office. The reliability of the SITARI system was confirmed through a pilot test involving 15 WRA participants prior to the main study, showing a concordance rate of ≥ 95 % with manual results for blood pressure and glucose data entry. Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize participant characteristics and outcome variables. Data normality was assessed using the Shapiro–Wilk test. Because the data did not meet normality assumptions, a Mann–Whitney U test was performed to compare screening speed and accuracy between the intervention and control groups. A p-value < 0.05 was considered statistically significant. Effect size was calculated to estimate the magnitude of the difference between groups. This study obtained ethical approval from the Ethics Committee of Poltekkes Kemenkes Semarang. All participants provided written informed consent prior to participation. Data confidentiality was maintained through anonymization of records and restricted system access to authorized research personnel only.

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RESULTS

A total of 118 women of reproductive age participated in the study, with 59 assigned to the intervention group (SITARI users) and 59 to the control group (manual screening). As presented in Table 1, most respondents in both groups had completed senior high school education (83.1% in the intervention group and 78.0% in the control group). Most participants were housewives (37.3% and 33.9%, respectively), followed by self-employed and college students. The distribution of educational level and occupation was relatively similar between groups, indicating comparable sociodemographic backgrounds.

Table 1. Sociodemographic characteristics of respondents (n = 118)

Variable	Category	Intervention n (%)	Control n (%)
Education	Junior High School	8 (13.6)	11 (18.6)
	Senior High School	49 (83.1)	46 (78.0)
	Diploma/Bachelor	2 (3.4)	2 (3.4)
Occupation	Housewife	22 (37.3)	20 (33.9)
	College Student	15 (25.4)	8 (13.6)
	Farmer	5 (8.5)	12 (20.3)
	Self-Employed	8 (13.6)	4 (6.8)
	Private Employee	7 (11.9)	10 (16.9)
	Government Employee	2 (3.4)	1 (1.7)

The relatively homogeneous distribution of education and occupation suggests minimal demographic bias between the two groups.

As shown in Table 2, the mean accuracy score among participants using the SITARI system was 100.00 (SD = 0.00), while that of the control group using manual screening was 71.32 (SD = 5.12). The *Mann–Whitney U test* indicated a statistically significant difference in screening accuracy between the two groups (U = 123.0, Z = –8.21, p < 0.001), with an effect size (r) of 0.74, representing a large magnitude of difference.

Table 2. Comparison of screening accuracy between intervention and control groups

Variable	Mean (SD)	Mean Rank	U	Z	p-value	Effect Size (r)
SITARI (n = 59)	100.00 (0.00)	89.00	123.0	–8.21	<0.001	0.74
Control (n = 59)	71.32 (5.12)	30.00				

Women who used the SITARI information system demonstrated perfect concordance (100%) between automated results and manual verification by health workers, whereas manual screening methods yielded lower consistency (71.32%). These findings indicate that SITARI substantially improves the accuracy and reliability of non-communicable disease (NCD) screening among women of reproductive age.

Table 3 presents the comparison of screening speed between groups. The average screening time in the SITARI group was 9.32 minutes (SD = 1.20), while the control group required an average of 20.12 minutes (SD = 2.10). The *Mann–Whitney U test* revealed a statistically significant difference in screening time (U = 145.0, Z = –7.85, p < 0.001, r = 0.71).

Table 3. Comparison of screening speed between intervention and control groups

Variable	Mean (SD)	Mean Rank	U	Z	p-value	Effect Size (r)
SITARI (n = 59)	9.32 (1.20)	30.00	145.0	–7.85	<0.001	0.71
Control (n = 59)	20.12 (2.10)	89.00				

The results demonstrate that the use of the SITARI digital information system significantly reduces screening time by an average of approximately 10.8 minutes per participant, representing a 54% improvement in screening efficiency. This reduction may have practical

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implications for large-scale NCD screening programs, particularly in resource-limited settings.

These findings suggest that integrating a digital information system such as SITARI into community-based screening programs can substantially improve both accuracy and operational efficiency. The significant reduction in screening time and elimination of human calculation errors support the potential of digital health innovations to strengthen early detection of non-communicable diseases among women of reproductive age.

However, while SITARI achieved perfect accuracy in this study, further validation in broader populations and longer-term use is warranted to ensure system robustness and generalizability.

DISCUSSION

This quasi-experimental evaluation demonstrates that the SITARI (Independent Non-Communicable Disease Screening Information System) substantially improved both the accuracy and speed of community-based screening for non-communicable diseases (NCDs) among women of reproductive age in Blora, Indonesia. Participants using SITARI achieved perfect concordance with verifier assessments (100% accuracy) and required, on average, approximately 10.8 fewer minutes per screening compared to those using conventional paper-based methods. These findings indicate that a small, rule-based digital tool can markedly enhance the reliability and efficiency of community screening activities with direct implications for early case detection, timely referral, and the operational capacity of primary health services in resource-limited settings.

The study further underscores the potential of locally developed digital innovations to strengthen early detection programs, improve screening accuracy, and optimize health workers' time in primary care contexts. The effectiveness of SITARI demonstrates that simple, user-friendly digital platforms can be successfully implemented even in rural or resource-constrained areas to improve health system performance and responsiveness.

This evidence aligns with Indonesia's national agenda to accelerate digital transformation in the health sector, as outlined in the *Satu Sehat* initiative by the Ministry of Health of the Republic of Indonesia, which emphasizes integrating digital health systems into community-level services.

Our findings are consistent with a growing body of evidence demonstrating that digital health interventions can enhance implementation outcomes such as timeliness, data completeness, and usability even when their effects on clinical outcomes remain variable. A recent scoping review reported consistent improvements in service delivery metrics and data quality across diverse digital NCD interventions, particularly in low- and middle-income countries (LMICs).(10) Similarly, systematic reviews of mHealth and provider-facing applications have shown that mobile and web-based platforms reduce recording errors, accelerate reporting, and facilitate task-shifting to community health workers benefits that mirror the mechanisms through which SITARI likely improved screening accuracy and speed.(11) The World Health Organization's global strategy on digital health underscores that well-designed, contextually adapted digital tools integrated into existing health system workflows are most likely to achieve such implementation benefits. The rule-based and user-centered design of SITARI is aligned with these global recommendations.(12)

Our results are also parallel to previous global and national research showing that digital health systems can improve data quality, accuracy, and service delivery efficiency. International studies have demonstrated that digital NCD screening systems reduce errors, shorten processing time, and support decentralized service delivery in LMICs.(10,13) The findings of this study are consistent with previous research on information systems for managing non-communicable diseases (NCDs) in Indonesia, which demonstrated that well-designed digital platforms aligned with community needs can effectively support NCD

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control efforts by facilitating and expanding access to health information.(14)(15) A similar web-based information system developed using the System Development Life Cycle (SDLC) and waterfall model produced more comprehensive data on eye, ear, and mental health examinations, as well as risk factor assessments based on age and sex. Data entry trials indicated that the system was easy to use and generated valuable health insights.(16) Other studies have also shown that web-based NCD detection systems are practical, as they can be accessed anytime and anywhere. Such systems have transformed the traditional approach to NCD management in the community: previously, health workers needed to interact directly with patients, whereas digital platforms now enable remote detection and diagnosis.(17) The SITARI information system demonstrated superior performance in NCD screening, particularly in terms of speed and accuracy of data collection. This enhancement facilitates earlier case detection, increases public awareness of individual health status, and encourages communities to engage more actively in adopting healthy lifestyles. Well-documented digital health data generated through SITARI can also strengthen NCD surveillance and control. Furthermore, the system shortens screening time while maintaining data completeness.

Women of reproductive age (WRA) represent a key population for health empowerment initiatives. The growing prevalence of NCDs among this group significantly affects not only maternal health but also the long-term well-being of future generations.(18) Recent studies indicate an increasing trend in chronic conditions among women such as malignancy, obesity, hypertension, and cardiovascular disease driven by factors including low health literacy, limited screening participation, poor diet quality, physical inactivity, and socioeconomic challenges.(19) (13)

The current findings align with national and international studies show that community-oriented digital health systems can improve NCD management. For instance, Aulia et al. (2020) reported that a community-based NCD information system successfully enhanced data completeness and accessibility.(15) Similarly, Wijayanti et al. (2019) found that digitized NCD recording at community health posts improved reporting accuracy and reduced manual workloads (20), while Kurniasih et al. (2022) demonstrated the effectiveness and user-friendliness of web-based screening platforms in rural communities.(17) Through SITARI, women of reproductive age can independently perform early NCD screening, promoting greater awareness and proactive health-seeking behavior. Effective NCD management requires understanding how individuals experience disease, the barriers they face in navigating healthcare, and the resources needed to improve daily life. Developing an adaptive, user-informed digital health system is therefore crucial for enhancing service delivery, community trust, and public health outcomes.(21)

The development of SITARI was guided by the principles of digitalization and inclusivity, designed as a rule-based “if–then” system encompassing all major NCD risk factors to ensure comprehensive screening coverage. Considering the increasing global burden of NCDs and lifestyle-related health transitions, such systematic, practical, and contextually adaptive digital interventions are urgently needed.(22) Empowering women of reproductive age through accessible digital health tools can help reduce NCD-related disability and premature mortality, ultimately improving productivity and overall quality of life.(23)

Several limitations should be acknowledged. First, the quasi-experimental posttest-only design and purposive sampling approach limit the strength of causal inference and the generalizability of the findings beyond the study communities. Second, the observed “perfect” accuracy in the SITARI group may reflect potential verification or measurement bias for example, if validation procedures overlapped with the system’s rule-based logic. Independent, blinded verification in larger and more heterogeneous populations is therefore warranted. Third, this study did not comprehensively assess implementation factors such

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as internet connectivity, digital literacy, user acceptability, system maintenance, and cost all of which are critical to determining long-term scalability and sustainability. Future research should employ randomized or longitudinal designs and incorporate mixed-methods implementation approaches to better capture user experience, adoption barriers, and contextual determinants of use. Cost-effectiveness analyses and interoperability testing with Indonesia's national electronic health record (*Satu Sehat*) are also recommended to assess scalability and data security. Furthermore, longitudinal follow-up studies are needed to determine whether SITARI's improvements in screening speed and accuracy translate into increased case detection, earlier diagnosis, and reductions in maternal complications associated with NCDs.

In summary, this study provides preliminary yet compelling evidence that a locally adapted, rule-based digital screening system (SITARI) can substantially improve the accuracy and efficiency of community-based NCD screening among women of reproductive age. If validated and scaled with attention to integration, usability, and equity, such tools could become a pragmatic component of national strategies to reduce NCD-related maternal morbidity and strengthen primary health care surveillance in resource-limited settings.

CONCLUSION

This study demonstrates that the SITARI (Independent Non-Communicable Disease Screening Information System) significantly improves both the accuracy and speed of NCD screening among women of reproductive age in Blora, Indonesia. The SITARI users achieved 100% screening accuracy and completed the process in less than half the time required by the conventional manual method. These findings highlight the potential of context-specific, rule-based digital tools to enhance the efficiency, reliability, and scalability of community-based screening programs in resource-limited settings.

The implementation of SITARI contributes not only to earlier case detection but also to increased health awareness and self-efficacy among women, thereby supporting national efforts to reduce maternal morbidity associated with NCDs. The results reinforce the importance of integrating digital health innovations into primary health care and align with the Indonesian Ministry of Health's digital transformation framework (*Satu Sehat*). Wider adoption of SITARI should be considered within community health programs such as *Posbindu PTM* and maternal health surveillance initiatives. Future research should include randomized controlled or longitudinal designs to validate long-term effects on health outcomes, assess cost-effectiveness, and evaluate interoperability with national health information systems. Continuous capacity building for health workers and digital literacy support for users will be essential to ensure sustainable implementation.

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